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# COMPARATIVE ANALYSIS OF BODY WEIGHT AND CONDITION IN TWO BROWN HARE POPULATIONS

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**ABSTRACT**
The condition of the populations are useful parameters for the reasonable game management. In this study the physical condition of Brown hare stocks (Lepus europaeus, Pallas 1785) was analyzed, measured body weight (BW) and determined kidney fat index (KFI). These methods were applied during our survey in the hunting period of 2014/15 and 2015/16. In total 272 (123 male and 149 female) samples were collected from two hunting areas in Great Plain (from County Békés and Jász-Nagykun Szolnok). The aim of our work was to collect data concerning the conditions of the populations. All hares was sexed and classified in 2 age groups (young <1years), and (old> 1years). The age was established by Stroh-mark in the hunting field and by dried eye lenses in the laboratory. BW and the weight of the kidney and perirenal fat was measured and the data were statistically analysed (group statistics, Levene's test for Equality of Variances and, t-tests for Equality of Means). As a result of our examination the range of KFI was 1.25-5.14. The weight of perirenal fat was between 2-34gramm.KFI was greater in females than males. The average BW of the hares in every age groups were less than it is according to literature dates, however the conditions of the hares were good and in very good in both hunting areas. The BW and the amount of the perirenal fat in adult female hares were the greatest.

**Keywords:** Brown hare, kidney fat index, KFI, condition, BW, age structure, Hungarian Great Plain

## INTRODUCTION

For the sustainable game management is essential to be aware of basic biological parameters of certain game population. The body condition can be an indicator of population dynamics, because it relates to birth and to death data (FARAGÓ AND NÁHLIK, 1997) too. There are several various practical methods for estimating condition such as BW measurement, bone marrow fat content and the size of thymus (SUGÁR, 1983). Thymus measurement is a suitable method for the condition estimation in young animals. The BW of hares give us valuable data series for estimating body conditions by sex and by age groups. On the basis of the assessment SZEDERJEI (1959) =163123). In the results of SZEKY (1973) the average body mass by male hares was 3.78 kg (n=1266) and by female hares 3.82 kg (n=1629). The color and the consistency of bone marrow are approximate. The proportion of the wet and dry weight of bone marrow give us more accurate information for estimating physical condition of animals (VERME AND HOLLAND, 1973). This method is particularly convenient for condition survey by dead animals. FRANZMANN AND LERESCHE (1978) estimate the condition by the value of blood hematocrit. The results of blood test can also be significantly influenced by the season, by the age of animals, by the level of hormone and by possible pregnancy. Derived data have great imtortance by estimating condition of animals such us KFI.

The value of KFI qualified in the case of big game:1-1.5 weak, 1.5-2 average and over 2 good (SUGÁR, 1983). STOTT AND HARRIS (2006) used always left kidneys and left perirenal fat in their examinations, because it was found to be reliable. FERNANDEZ ET AL. (2010) established the physical statement of animal from the hundredfold value of the proportion of freshly removed perirenal fat and kidney weight. The condition of hares change according to the nutrition supply and reproductive time. By fertile females the condition is in breeding time the best during the year (HANKS, 1981). Fat reserves arise the most intensively in the abdomen by lactating female hares which cover breastfeeding STOTT AND HARRIS (2006). There are relationship between the number of embryos, the stage of pregnancy and the KFI change FERNANDEZ ET AL. (2010). The spermatogenesis of male hares with good physical condition began earlier and its oestrous cycle took longer (SZÉKY AND LENNER, 1973). The yearly lipid intake and fatty acid components in digestive systeme of Brown hares was examined by POPESCU ET AL. (2011). The amount of lipid intake in May was average and in November maximal. Lactating female hares prefer plants which contains much linolenic acid e.g *Glycine, Papaver, Trifolium, Panicum and Medicavo* species. FERNANDEZ ET AL. (2010) KFI value in female hares was the greatest in reproductive period. RÖDEL ET AL. (2005) obseved that European rabbit (*Oryctolagus cuniculus L., 1758)* with smaller body size began the breeding period later but the litter size didn't differ significantly. By the result of GÁL (2006) there is a relationship between the KFI and lung worm infestation (*Prorostrongylus tauricus* and *Protostrongylus pulmonaris*). It is not proven in the case of infestation by *Trichuris leporis* species.

## MATERIAL AND METHOD

The aim of our examinations was to determine and to compare the body conditions of two European Brown hare populations in Hungarian Great Plain, where the species can be found in relatively high abundance. Places of origin of samples were from Túrkeve (47° 7' 9" N and 20° 49' 15.5" E) in Jász-Nagykun Szolnok county (n=86 in 2014) and (n=49 in 2015) and from Békéscsaba (46° 43' 49.5" N and 20° 56' 12" E) (n=68 in 2014) and (n=69 in 2015) in Békés county. Most parts of the two areas are under agricultural cultivation: mainly arables, meadows and pastures. The total 272 samples necessary for the research were collected from the hunting period of 2014-2015 and 2015-2016 from 1 October until 31December. Hares were weighed (BW) and their sex was determined immediately after the shot by external genital organs. Age estimation was made by the existence of the Stroh-mark and by the weight of dried eye lenses under laboratory conditions. The animals were divided into two age groups: dried eye lenses weight less than 280 mg (juvenile) and heavier than 280 mg (adult), based on (KŐHALMY, 1999). For the purpose of condition estimation we collected kidneys and renal fat (kidney fat index – KFI). The weight of kidneys and separeted perirenal fat was measured accurately grams and devided by age groups, sex and hunting areas. We analysed the data with the statistical program SPSS 22.($P < 0.05$) and Microsoft Excel. We applied-Levene's test for Equality of Variances and, t-tests for Equality of Means. We compared the conditions of Brown hares by age groups, sex and hunting areas. KFI was calculated by formula used SUGÁR (1983) for determine of body conditions of big games:

$$\text{KFI} = \frac{\text{the weight of the kidneys} + \text{the weight of the perirenal fat}}{\text{the weight of the kidneys}}$$

## RESULTS

Age structure and average BW:

Hunting bag considered to be representative in our opinion (in both areas and parts of areas were more times hunting and high number of shot hares) (*Table 1*). There was significant difference between hunting areas and sexual composition of populations in samples which were collected in 2014 (Sig<0.001 Std. error 0.078). In 2015 there was no significant difference between either the sexual composition (Sig 0.825 Std. error 0.094) or the age structures (Sig 0.519 Std. error 0.094) of the two areas. The average BW of male hares was 3442 g and female ones 3433g in "Túrkeve" (*Table 1*). In 2015 by males 3534 g and by females 3791 g. In hunting area Békéscsaba the average BW of male hares was 3484g (in 2014) and 3454 g (in 2015) and by the female ones 3224 g (in 2014) 4126 g (in 2015). The average BW of juvenile male hares was 3253g (n=77), and the average BW of juvenile females 3491 g (n=79). The average BW of adult male hares was 3705 g (n=46) and by the female ones 3796 g (n=70). The variance of the BW and age groups in hunting season 2014/15 were homogeneous by Levene-test (Sig. 0.282) but on the basis of the two-sample t-test sample means are different from each other Sig. (2-tailed) <0.001 by 95% confidence level (Std.error 49.632). The variance of the BW and age groups in hunting season 2015/16 were homogeneous as well (Sig. 0,108) and sample averages are different too Sig. (2-tailed) 0,047 by 95% confidence level (Std.error 101.032).

**Table 1. The average BW of the hares taking into account the sex and age structure (based on dried eye-lens)**

| hunting field/ year* | Male (♂) | | | | | |
|---|---|---|---|---|---|---|
| | Total** | J[a] | A[a] | J[b] | A[b] | Average (♂) |
| 104/2014 | 29 | 21 | 8 | 3266 | 3702 | 3484 |
| 101/2014 | 42 | 26 | 16 | 3109 | 3776 | 3442 |
| 104/2015 | 31 | 13 | 18 | 3469 | 3439 | 3454 |
| 101/2015 | 21 | 17 | 4 | 3167 | 3902 | 3534 |
| Average | | | | 3253 | 3705 | 3478 |
| | Female (♀) | | | | | |
| | Total** | J[a] | A[a] | J[b] | A[b] | Average (♀) |
| 104/2014 | 57 | 31 | 26 | 3036 | 3412 | 3224 |
| 101/2014 | 26 | 22 | 4 | 3151 | 3716 | 3433 |
| 104/2015 | 38 | 18 | 20 | 4164 | 4089 | 4126 |
| 101/2015 | 28 | 8 | 20 | 3614 | 3969 | 3791 |
| Average | | | | 3491 | 3796 | 3643 |

Source: FARKAS (2016)

*: hunting field/ year

**:total

[a]: age group: J – juvenile; A – adult

[b]: average BW (g)

Age structure and KFI:

The average KFI of the hunting bags taking into account the sex and age structure in both hunting season showed the *table 2*. The average KFI of male hares in Túrkeve was 2.60 (in 2014) and 2.28 (in 2015) and by female ones 2.62 (in 2014) and 2.30 (in 2015). In county

Békés the average KFI of male hares was 2.57 (in 2014) and 2.22 (in 2015). By female hares 2.72 (2014) and 2.25 (2015). The average KFI was in total male hares 2.58 (in 2014) and 2.25 (in 2015). By total female hares was this index 2.67 (2014) and 2.27 (in 2015).

**Table 2. The average KFI of the hares taking into account the sex and age structure (based on dried eye-lens)**

| hunting field/ year* | Male (♂) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total** | J[a] | A[a] | J[b] | A[b] | Average (♂) | |
| 104/2014 | 29 | 21 | 8 | 2,69 | 2,45 | 2,57 | 2,58 |
| 101/2014 | 42 | 26 | 16 | 2,56 | 2,64 | 2,60 | |
| 104/2015 | 31 | 13 | 18 | 2,21 | 2,24 | 2,22 | 2,25 |
| 101/2015 | 21 | 17 | 4 | 2,43 | 2,14 | 2,28 | |
| | Female (♀) | | | | | | |
| | Total** | J[a] | A[a] | J[b] | A[b] | Average (♀) | |
| 104/2014 | 57 | 31 | 26 | 2,67 | 2,77 | 2,72 | 2,67 |
| 101/2014 | 26 | 22 | 4 | 2,50 | 2,75 | 2,62 | |
| 104/2015 | 38 | 18 | 20 | 2,45 | 2,05 | 2,25 | 2,27 |
| 101/2015 | 28 | 8 | 20 | 2,11 | 2,50 | 2,30 | |

Source: FARKAS (2016)
*: hunting field/ year
**:total
[a]: age group: J – juvenile; A – adult
[b]: average KFI by age groups

These index values are typical of populations in good conditions. The range of kidney weights were between 5 and 13 grams and the weight of perirenal fat were 2-34 grams. The range of KFI in total were between 1.25 and 5.14 (in 2014) and between 1.41 and 4.14 (in 2015). The variance of the KFI by hunting areas in the hunting season 2014/15 were homogeneous according to the Levene-test (Sig.: 0.565) and on the basis of two-sample t-test sample means aren't different from each other Sig. (2-tailed) 0.435 by 95% confidence level. In 2015 the variance of the KFI by hunting areas were not homogeneous by Levene-test (Sig<0.05) but on the basis of the two-sample t-test sample means aren't different from each other Sig. (2-tailed) 0.097 by 95% confidence level. The variance of the KFI by age groups in total examined was homogeneous in both hunting seasons (Sig.: 0.131) (in 2014) and (Sig.: 0.832) (in 2015). There wasn't significant difference Sig (2-tailed) 0.568 (Std error 0.77) (in 2014) and Sig (2-tailed) 0.711 (Std error 0.09) (in 2015) by 95% confidence level.

## DISCUSSION

Although knowledge of condition of individuals provide useful information for proffesional hunters about their populations it must take into consideration that sick or weak animals often does not get into the sample. To knowing more accurate data about the condition we needed samples from dead hares which were found somewhere e.g roadkill. It would be suitable for the other estimating method for conditions applied together such us KFI combinated with the proportion of the wet or dry weight of bone marrow fat. In our results the average BW of jung male hares (3253 g, n=77) was less than

the average BW of jung female ones (3491 g, n=79). In the survey of PINTUR ET AL. (2006) in Croatia the average BW of jung male hares was calculated 3580 g and by jung female hares 3410 g. In our study the average BW of adult male hares 3705 g (n=46) was less than that of adult female ones (3796 g). Opposite of the results of PINTUR ET AL. (2006) in Croatia where the average BW of adult male hares were 3840 g and by the adult female ones were 3660 g (n=279). The average BW of total male hares was 3478 g (n=123) and that of the females was 3643 g (n=149) this value is less than data of SZÉKY (1973): 3780 g (♂) and 3820 g (♀). Of course the BW and KFI value depend on more factors e.g habitat quality, time of collecting samples, weather. In both hunting areas and hunting seasons the two populations were in good and excellent conditions but the average BW were less than in other authors. In both years the KFI of female hares were higher than in male ones. The average KFI of male hares in total were 2.58 (in 2014) and 2.25 (in 2015). This index by total female hares were 2.67 (in 2014) and 2.27 (in 2015).

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